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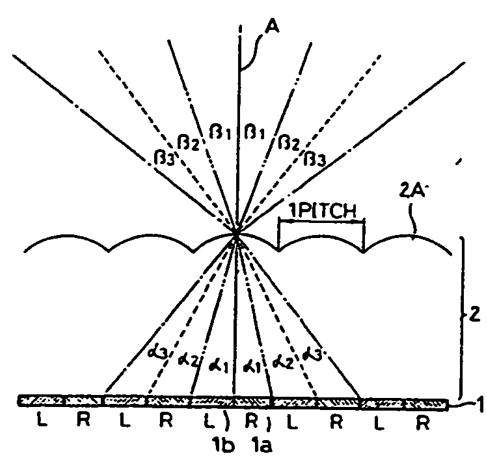
(54) Technique of stereoscopic image display.

(57) The technique uses a viewing lenticular lens sheet constituted by an array of lenticular lenses on which a combined image obtained by combining pixels for the right and left eye images having binocular disparity data. This technique comprises the steps of :
detecting a position of the viewer ; and
changing positions of the pixels for the right and left eye images on the combined image in accordance with the detected position of the viewer, so that the right and left eye images are always correctly provided to the right and left eyes of the viewer.

FIG. 1



EP 0 354 851 A2

Description

Technique f St re sc pic Image Display

BACKGROUND OF THE INVENTION:

(Field of the Invention)

The present invention relates to a technique of stereoscopic image display applicable to stereoscopic television sets, stereoscopic video recorders/ players, stereoscopic videotelephones for performing communications at remote locations, and the like.

(Description of Prior Art)

Techniques of displaying a stereoscopic image (three-dimensional image) include a glass scheme using specific glasses, and a lenticular scheme using a lenticular lens sheet. In the glass scheme, a scheme of displaying a stereoscopic image using polarized glasses, liquid-crystal shutter glasses, or an anaglyph scheme is known. In the glass scheme, a viewer of a stereoscopic image feels unnatural and uneasy since he or she must wear glasses. Especially, for stereoscopic videotelephones with which viewers make conversations while watching each other, since images wearing glasses are displayed, naturalness is considerably impaired.

On the other hand, a technique of displaying a stereoscopic image by the lenticular scheme includes a direct viewing type wherein a lenticular lens sheet is arranged on the surface of a display such as a CRT, a liquid-crystal display, or the like, and a projection type for projecting an image on a lenticular lens sheet using a projector.

With the lenticular scheme, a viewer can watch a st reoscopic image without wearing glasses. However, in order to assure stereoscopic viewing in a wide range, a large number of images projected from 6 to 8 places are required, and the arrangement of an apparatus becomes complicated and the apparatus becomes expensive. As a technique for realizing such a lenticular scheme by images projected from two places, a technique for mechanically tracking a head portion is known (e.g., Alfred Schwartz; "Head Tracking Display" IEEE Trans. ED-33, 8 (Aug, 1986)). However, a tracking speed cannot be increased due to mechanical tracking.

SUMMARY OF THE INVENTION:

It is an object of the present invention to provide a technique of stereoscopic image display which can assure electronic stereoscopic viewing within a wide range without using glasses.

It is another object of the present invention to provide a technique which can eliminate a drawback that a discontinuous stereoscopic image is formed when a viewer mov s his or her head, and which can continuously and naturally display a stereoscopic image and can expand an area capable of stereoscopic viewing.

It is still another object of the present invention to provide a technique which can assure stere sc pic viewing within a wide range regardless of whether the direct viewing or projection type display is employed.

According to the present invention, when a stereoscopic image is viewed using a lenticular lens sheet for viewing a combined image obtained by combining pixels for right and left eye images each having a binocular disparity, the binocular position of a viewer is detected by a detection means so that the pixel for the left eye image is always incident on the left eye and the pixel for the right eye image is always incident on the right eye, and the positions of the pixels for the right and left eye images on the combined image are changed on the basis of the detection signal according to the binocular position of the viewer.

More specifically, when the direct viewing type display is employed, right and left eye images displayed by a display device such as a liquid-crystal display are controlled by detecting the binocular position of the viewer. When the projection type display is employed, a right or left eye image signal which is input to a corresponding one of two (or a plurality of sets of) projectors is controlled by detecting the binocular position of the viewer.

According to the present invention, in order to allow stereoscopic viewing of the entire display screen, the pitch of each lenticular lens is set to be slightly smaller than the repetitive pitch of a pair of pixels for right and left eye images on the combined image, so that the centers of all the pairs of pixels for the right and left eye images are projected to the center of the two eyes.

Furthermore, according to the present invention, each pixel of a pair of pixels for right and left eye images corresponding to one pitch of the lenticular lens is constituted by a plurality of micropixels, and the positions of pixels for the right and left eye images on the combined image are changed in units of micropixels, thus expanding an area capable of stereoscopic viewing.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figs. 1 to 4 show the principle of the present invention, in which

Fig. 1 is a view showing a state near a display screen,

Fig. 2 is a view showing a state near a viewer,

Fig. 3 is a view simultaneously showing states near the display screen and the viewer when the viewer is just in front of the display screen, and

Fig. 4 is a view simultaneously showing states near the display screen and the viewer when the viewer moves to the right or left from the front position;

Figs. 5(A) and 5(B) show an arrangement and principle of a projection type display, in which Fig. 5(A) shows a projection display with a front projection screen, and Fig. 5(B) shows a projection display with a back projection screen;

Fig. 6 is a block diagram showing an arrangement of a direct viewing type display according to an embodiment of the present invention;

Fig. 7 is a block diagram showing an arrangement of a projection type display;

Fig. 8 is a view for explaining a problem posed when a pitch of a lenticular lens is equal to a pitch of a pair of pixels for right and left eye images;

Fig. 9 is a view for explaining optical characteristics of an embodiment which assures stereoscopic viewing of the entire display screen according to the present invention;

Figs. 10(A) and 10(B) are views showing areas capable of stereoscopic viewing when a pair of of pixels for right and left eye images correspond to one lenticular lens; and

Figs. 11(A) and 11(B) are views showing areas capable of stereoscopic viewing when each of pixels for right and left eye images is constituted by two micropixels in correspondence with one lenticular lens in order to expand the areas capable of stereoscopic viewing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT:

The present invention will now be described in detail with reference to the accompanying drawings.

Figs. 1 to 4 are views for explaining the principle of the present invention. Fig. 1 shows a state near a display screen (direct viewing type) or a diffusive layer (projection type). In Fig. 1, reference numeral 1 denotes a combined image obtained by combining pixels for a left eye image (to be referred to as L pixels hereinafter) and pixels for a right eye image (to be referred to as R pixels hereinafter). Each pair of R and L pixels correspond to each of lenticular lenses 2A constituting a lenticular lens sheet 2. The combined image 1 is formed on a focal plane of the lenticular lenses 2A. A light beam passing through the central lenticular lens 2A will be explained below. Light emerging from the right end of an R pixel 1a located immediately below the central lenticular lens 2A is incident on the lenticular lens 2A at an angle α_1. Similarly, light emerging from the left end of an L pixel 1b is incident on the lenticular lens 2A at the same angle α_1. These light beams comply with the law of refraction expressed by the following equation when they emerge from the lenticular lens 2A:

$$n \cdot \sin(\alpha_1) = \sin(\beta_1)$$

where β_1 is the emerging angle, and $\underline{n}$ is the refractive index of the lenticular lens 2A. In this arrangement, when the position of a viewer is set so that the extending line of a perpendicular A of the combined image 1 passes through the center between the two eyes of the viewer, the viewer can njoy stereoscopic viewing. Since the R and L pixels are arranged adjacent to each other, light beams which are incident at an angle α_2 and emerge at an angle β_2 are present outside the light beams emerging from the R and L pixels 1a and 1b, and light beams which are incident at an angle α_3 and emerge at an angle β_3 are similarly present outside these light beams.

Fig. 2 shows the above-mentioned state as well as the viewer. In Fig. 2, when a viewer 5 is located at the central position indicated by a solid line, since light beams emerging at the angle β_1 are incident on his or her two eyes, he can enjoy stereoscopic viewing. However, when the viewer 5 moves to the right or left and is located at a position indicated by a broken line, light components corresponding to L pixels are incident on the right eye and light components corresponding to R pixels are incident of the left eye, so that stereoscopic view cannot be assured. Thus, when the viewer 5 moves to the position indicated by the broken line, if the positions of the R and L pixels on the combined image 1 are reversed, stereoscopic viewing is assured.

Fig. 3 shows a state wherein the viewer 5 is located just in front of the display screen, and Fig. 4 shows a state wherein the viewer 5 moves to the right or left. In Figs. 3 and 4, the lenticular lens 2A is enlarged and the viewer 5 is reduced in scale for the sake of convenience. Fig. 3 simultaneously shows the relationship between Figs. 1 and 2. A right eye light beam emerging from the R pixel 1a is incident on the right eye of the viewer 5, and a left eye light beam emerging from the L pixel 1b is incident on the left eye, thus achieving stereoscopic viewing. In Fig. 4, when the viewer 5 moves to the right or left and emerging light beams at the angles β_1 and β_2 are incident on two eyes, if the R and L pixels on the combined image 1 are reversed to those shown in Fig. 3, light components corresponding to R and L pixels are respectively incident on the right and left eyes of the viewer 5, thus achieving stereoscopic viewing. In order to reverse the R and L pixels on the combined image 1, right and left eye signals input to display elements of a display device can be reversed in a direct viewing type display. On the other hand, in a projection type display, right and left eye image signals input to projectors are reversed. When the observer 5 further moves to the right or left and light beams at angles β_2 and β_3 are incident on the two eyes of the viewer 5, the combined image 1 can be controlled to have the same array of pixels as that shown in Fig. 3. When the viewer further moves to a position where he or she receives still outer light beams, the combined image 1 can be controlled to have the same array of pixels as that shown in Fig. 4, thus assuring stereoscopic viewing. More specifically, a binocular or head position of the viewer 5 is detected to control the array of pixels on the combined image 1, so that stereoscopic viewing can be attained even if the viewer 5 moves.

Note that a technique for detecting the binocular or head position of the viewer is known to those who are skilled in the art (reference: Proc. of SPIE, Visual Communication and Image Processing, 1988, Vo. 1001, K. OHMURA et al.), and a binocular or head position detective equipment is commercially available (e.g., infrared sensor: E_3SA-$DS50C_{43}A$ available from OMRON TATEISHI ELECTRONICS CO., ultrasonic sensor: PS_1-D_1MN available from FUJI ELECTRIC CO., LTD., and the like.)

The arrangement and principle of the projection type display will be described below.

Figs. 5(A) and 5(B) show top views of the

arrangement of the projection type display. More specifically, Fig. 5(A) shows an arrangement of a projection display with a front projection screen, and Fig. 5(B) shows an arrangement of a projection display with a back projection screen. In Figs. 5(A) and 5(B), reference numeral 11 denotes a lenticular lens sheet; 12, a diffusive layer arranged on the rear surface of the lenticular lens sheet; 13, a projector for projecting a right eye image toward the lenticular lens sheet; 14, a projector for projecting a left eye image; and 15, a viewer.

In the projection display with the front projection screen shown in Fig. 5(A), the projectors 13 and 14 and the viewer 15 have the following relationship. That is, the projectors 13 and 14 are arranged immediately above or below the two eyes of the viewer 15. When the projectors 13 and 14 respectively project right and left eye images onto the lenticular lens sheet 11, light beams emerging from the projectors 13 and 14 are reflected by the diffusive layer 12 on the rear surface of the lenticular lens sheet 11 and are returned along the perpendiculars including the projectors. Thus, as indicated by dotted lines, the light beam projected from the projector 13 reaches the right eye of the viewer 15, and the light beam projected from the projector 14 reaches the left eye of the viewer 15. As a result, the viewer can view a stereoscopic image on the lenticular lens sheet. More specifically, an image projected from the projectors is focused on the diffusive layer arranged on the rear surface of the lenticular lens sheet as a combined image consisting of R and L pixels, and the viewer stereoscopically views the focused image through the lenticular lens sheet, as shown in Fig. 4.

In the projection display with the back projection screen shown in Fig. 5(B), two lenticular lens sheets are in tight contact with each other to sandwich the diffusive layer 12 therebetween. The projectors 13 and 14 and the viewer 15 are symmetrically arranged with respect to the lenticular lens sheets. With this arrangement, when the projector 13 projects a right eye image and the projector 14 projects a left eye image, the light beam emerging from the projector 13 passes through the lenticular lens sheets 11 and then reaches the right eye of the viewer 15, as indicated by dotted lines, and the light beam merging from the projector 14 reaches the left eye of the viewer, as indicated by solid lines. Thus, the vi wer can view a stereoscopic image in the same manner as in the projection display shown in Fig. 5(A).

The above description has been made for a case wherein two projectors are used. Of course, more than two projectors may be used to project images.

Note that the principle of these projectors is known to those who are skilled in the art, and a detailed description thereof will be omitted (reference: "Three-Dimensional Image Optics", T. OHKOSHI, Sangyo Tosh Shuppan, Co.)

The arrangement of an embodiment f the present invention using the principle shown in Figs. 1 to 5(B) will b described below.

Fig. 6 is a block diagram showing an arrangement of the direct viewing type display. In Fig. 6, reference numerals 21 and 22 denote right and left eye signal sources of a binocular disparity signal source; 23, a multiplex circuit of binocular signals; 24, a binocular position detective circuit for detecting the binocular position of the viewer 5 shown in Figs. 2 to 4; 25, a right and left image array control circuit for controlling an array of a combined image formed on a stereoscopic display device; and 26, a stereoscopic display device. The display device 26 corresponds to a combination of a lenticular lens sheet and a substantially flat liquid-crystal display device.

The operation of the system with the above arrangement will be described below. Signals from the right and left signal sources 21 and 22 of the binocular disparity signal source such as a television camera, a video disk player, a video tape recorder (VTR), or the like are combined by the multiplex circuit 23. In this case, the right and left image array control circuit 25 forms a signal for controlling an array of a combined image on the display device based on a binocular position signal as an output from the binocular or head position detective circuit 24 which detects the binocular or head position of the viewer, and applies the signal to the multiplex circuit 23 to control a combination of the binocular signals. The resultant signal is applied to the stereoscopic display device 26 to control an array of R and L pixels on the combined image 1, as shown in Fig. 3 or 4. Therefore, the viewer can enjoy stereoscopic viewing even if he moves to the right or left.

Fig. 7 is a block diagram showing the projection type display. In Fig. 7, reference numeral 31 denotes a projector for projecting a right eye signal; 32, a projector for projecting a left eye signal; 33, a switch unit for switching the right and left eye signal sources; 34, a binocular or head position detective circuit; 35, a selector for controlling the switching operation of the switch unit 33; R, a right eye signal input terminal; and L, a left eye signal input terminal.

The operation of the system with the above arrangement will be described below. Right and left eye signals from the binocular disparity signal source such as a television camera, a video disk player, a video tape recorder (VTR), or the like are input to the terminals R and L, respectively. In this case, the selector 35 selects signals to be input to the two projectors 31 and 32 on the basis of the binocular position signal from the binocular or head position detective circuit 34 which detects the binocular or head position of the viewer, and controls the switch unit 33. For example, when the viewer 5 is located at the central position, as shown in Fig. 3, the signal at the terminal R is input to the projector 31 and the signal at the terminal L is input to the projector 32, so that R and L pixels are arrayed on the combined image 1 in the order shown in Fig. 3. When the viewer 5 moves to the right or left and is located, as shown in Fig. 4, the selector 35 controls the switch unit 33 to switch the input signals to the projectors 31 and 32, so that R and L pixels are arrayed on the combined image in the order, as shown in Fig. 4. Therefore, the viewer can enjoy stereoscopic viewing even if he moves to the right or left.

A method of assuring st r oscopic viewing on the entire surface of a display over the viewing distance of a stereoscopic image by adhering a lenticular lens sheet on a substantially flat surface of the display will be described below.

Fig. 8 is a view for explaining the above-mentioned problems of the present invention. For the sake of illustrative convenience, lenticular lenses are illustrated as convex lenses. The thickness of each lenticular lens corresponds to a product of the refractive index of the lenticular lens and a focal length f′ of a convex lens. In Fig. 8, reference numeral 51 denotes a combined image consisting of pixels 51-a for a right eye image (R pixels) and pixels 51-b for a left eye image (L pixels) to display a two-eye scheme stereoscopic image. The length of each R (L) pixel is represented by ℓ, and a repetitive pitch of pairs of R and L pixels is represented by 2ℓ. Reference numeral 52 denotes a convex lens sheet constituted by a large number of convex lenses 52A. A pitch of the convex lenses 52A is represented by P, and a focal length is represented by f. Reference numeral 53 denotes a viewer who is located right in front of a display screen, and views an image at a distance D from the convex lenses 52A (although the two eyes are located farther than the position corresponding to the distance D for the sake of illustrative convenience, they are present at the position of the distance D, in practice.) The R (L) pixel is projected to have a size e at the stereoscopic viewing distance D. In Fig. 8, the pitch 2ℓ of the pairs of R and L pixels is equal to the pitch P of the convex lenses. In this case, an R pixel $51\text{-}a_1$ of a pair of central R and L pixels ($51\text{-}a_1$ and $51\text{-}b_1$) is projected t a right eye 53a of the viewer 53 at the position of the distance D, and the L pixel $51\text{-}b_1$ is projected to a left eye 53b, thus allowing stereoscopic viewing. On the other hand, of a pair of R and L pixels ($51\text{-}a_m$ and $51\text{-}b_m$) at the right end portion of the screen, the R pixel $51\text{-}a_m$ is projected to the left eye 53b of the viewer 53, and the L pixel $51\text{-}b_m$ is projected to neither eyes, thus disturbing stereoscopic viewing. The same applies to a pair of R and L pixels ($51\text{-}a_n$ and $51\text{-}b_n$) at the left end portion of the screen, and stereoscopic viewing is disturbed. That is, if the pitch 2ℓ of the pairs of R and L pixels is set to be equal to the pitch P of the convex lenses 52A, the viewer 53 cannot enjoy stereoscopic viewing on the entire display screen.

Fig. 9 shows an embodiment of the present invention and is used to explain optical characteristics of the convex lenses 52A and the combined image 51 capable of stereoscopic viewing on the entire display screen. Fig. 9 illustrates lenticular lenses as convex lenses as in Fig. 8. In Fig. 9, the viewer 53 is located just in front of the display screen, and views an image at the distance D from the convex lenses 52A. Although the two eyes 53a and 53b are located farther than the position corresponding to the distance D for the illustrative conveni nce in Fig. 9 as in Fig. 8, the two eyes are located at the position of the distance D in practice. The pitch P of the convex lenses 52A is set to be slightly smaller than the pitch 2ℓ of the pair of R and L pixels, so that centers 50 of all the pairs of R and L pixels are project d to a center 55 between the two eyes at the distance D. The condition to obtain this state is represented by the following equation:

$P = 2\ell \cdot D/(D + f')$ (1)

If the pitch 2ℓ of the pairs of R and L pixels is 0.4 mm, the stereoscopic viewing distance D is 500 mm, and the focal length f′ of the convex lens is 1.56 mm, the pitch P of the convex lenses allowing stereoscopic viewing on the entire screen is about 0.3988 mm. The stereoscopic visible area e at the distance D, the focal length f′ of the convex lens, and the length ℓ of the R or L pixel satisfy the following equation:

$f' = \ell \cdot D/e$ (2)

In equation (2), if f′ = 1.56 mm, D = 500 mm, and ℓ = 0.2 mm, the stereoscopic visible area e is about 64 mm.

An average interval between the two eyes of a person is about 64 mm. Therefore, when the R or L pixel is enlarged and projected in a size approximate to the interval between the two eyes of a person, a maximum visible area can be obtained and the viewer can enjoy stereoscopic viewing over the entire screen of the display.

This method can be applied to either of the direct viewing and projection type displays.

In the above embodiment, each of L and R pixels corresponding to one lenticular lens is constituted by one pixel. In this case, when the viewer moves to the right or left while the distance between the viewer and the lenticular lens sheet remains the same, the binocular position of the viewer is detected to switch the positions of the R and L pixels on the combined image, thus continuously allowing stereoscopic viewing. However, when the viewer moves to the right or left with a forward or backward offset, an area incapable of stereoscopic viewing is formed. When each of L and R pixels corresponding to one lenticular lens is constituted by a plurality of micropixels (e.g., two micropixels for each of R and L pixels; a total of four micropixels), an area capable of stereoscopic viewing can be expanded.

Fig. 10 shows a case wherein one pitch of the lenticular lenses corresponds to a pair of R and L pixels each including one pixel, and is equal to the case of Fig. 9. In Fig. 10, reference symbol P denotes a pitch of the lenticular lenses; f, a focal length of the lenticular lens; D, a stereoscopic viewing distance; and 2ℓ, a pitch of pairs of R and L pixels, which is slightly larger than the pitch P of the lenticular lenses. Reference symbol e denotes a stereoscopic visible area almost corresponding to an interval between the two eyes of the viewer. Reference numeral 101 denotes areas capable of viewing of the R pixels; and 102, areas capable of viewing of the L pixels.

When the right eye of the viewer is present in an area 101 and at the same time, his left eye is present in an area 102, he can enjoy stereoscopic viewing over the entire display screen. Therefore, for example, when the viewer is pres nt at the center of Fig. 10(A) (along an alternate long and short dashed line) and slightly moves forward or backward from the position corresponding to the distance D,

stereoscopic viewing over the entire display screen can be assured. When the binocular position of the viewer is at the distance D and the viewer moves to the right or left, the array of the R and L pixels is switched according to the binocular position of the viewer, thus continuously assuring stereoscopic viewing. However, when the viewer moves to the right or left with a forward or backward offset from the position of the stereoscopic viewing distance D, even if the array of a combined image 100 is switched, one or both of the right and left eyes fall outside the areas 101 and 102, and an area incapable of stereoscopic viewing is formed.

Fig. 11 shows an embodiment for expanding an area capable of stereoscopic viewing, and shows a case wherein one pitch of the lenticular lenses corresponds to a pair of R and L pixels each constituted by two pixels. If two R pixels are represented by R_1 and R_2 and two L pixels are represented by L_1 and L_2, four combinations of arrays, i.e., R_1-R_2-L_1-L_2, L_1-L_2-R_1-R_2, L_2-R_1- R_2-L_1, and R_2-L_1-L_2-R_1 can be obtained. The four combinations of arrays are shown in Figs. 11(A) and 11(B). Ranges of the areas 101 and 102 differ depending on the four combinations of arrays. Therefore, upon switching of the four combinations, the ranges of the areas 101 and 102 are expanded up to the ranges added with the ranges shown in Figs. 11(A) and 11(B). More specifically, even if the viewer moves to the right or left while his two eyes are offset forward or backward from the position of the stereoscopic viewing distance D, the binocular position of the viewer is detected to switch the four combinations of arrays, thus continuously assuring stereoscopic viewing.

If the number of micropixels constituting each of R and L pixels corresponding to one lenticular lens is increased, ranges capable of stereoscopic viewing can be further expanded over the entire display screen.

Claims

1. A technique of stereoscopic image display for providing right and left eye images to right and left eyes of a viewer using a viewing lenticular lens sheet constituted by an array of lenticular lenses on which a combined image obtained by combining pixels for the right and left eye images having binocular disparity data, comprising the steps of:
detecting a position of the viewer; and
changing positions of the pixels for the right and left eye images on the combined image in accordance with the detected position of the viewer, so that the right and left eye images are always correctly provided to the right and left eyes of the viewer.

2. A technique according to claim 1, wherein said technique is realized by an arrangement in which a repetitive pitch of said lenticular lenses of said lenticular lens sheet is set t be smaller than a repetitive pitch of pairs of pixels for the right and left eye images on the combined image.

3. A technique according to claim 1 or 2, wherein one lenticular lens corresponds to one pair of pixels for the right and left eye images on the combined image, and the step of changing the positions of the pixels for the right and left eye images on the combined image includes the step of replacing the positions of the pixels for the left and right eye images.

4. A technique according to claim 1 or 2, wherein each of the pixels for the right and left eye images corresponding to one lenticular lens is constituted by a plurality of micropixels, and the step of changing the positions of the pixels for the right and left eye images on the combined image is executed in units of micropixels.

5. A technique according to any one of claims 2, 3, and 4, wherein the combined image comprises the right and left eye images displayed by a display device arranged behind a rear surface of said viewing lenticular lens sheet.

6. A technique according to any one of claims 2, 3, and 4, wherein the combined image comprises an image obtained by focusing the right and left eye images projected from a plurality of projectors arranged on the side of the viewer on a diffusive layer arranged on a rear surface of said viewing lenticular lens sheet by said lenticular lenses of said viewing lenticular lens sheet.

7. A technique according to any one of claims 2, 3, and 4, wherein the combined image comprises an image obtained by focusing the right and left eye images projected from a plurality of projectors arranged on a side opposite to the viewer with respect to said viewing lenticular lens sheet on a diffusive layer arranged on a rear surface of said viewing lenticular lens sheet by lenticular lenses of a lenticular lens sheet having the same performance as that of said viewing lenticular lens sheet.

FIG. 1

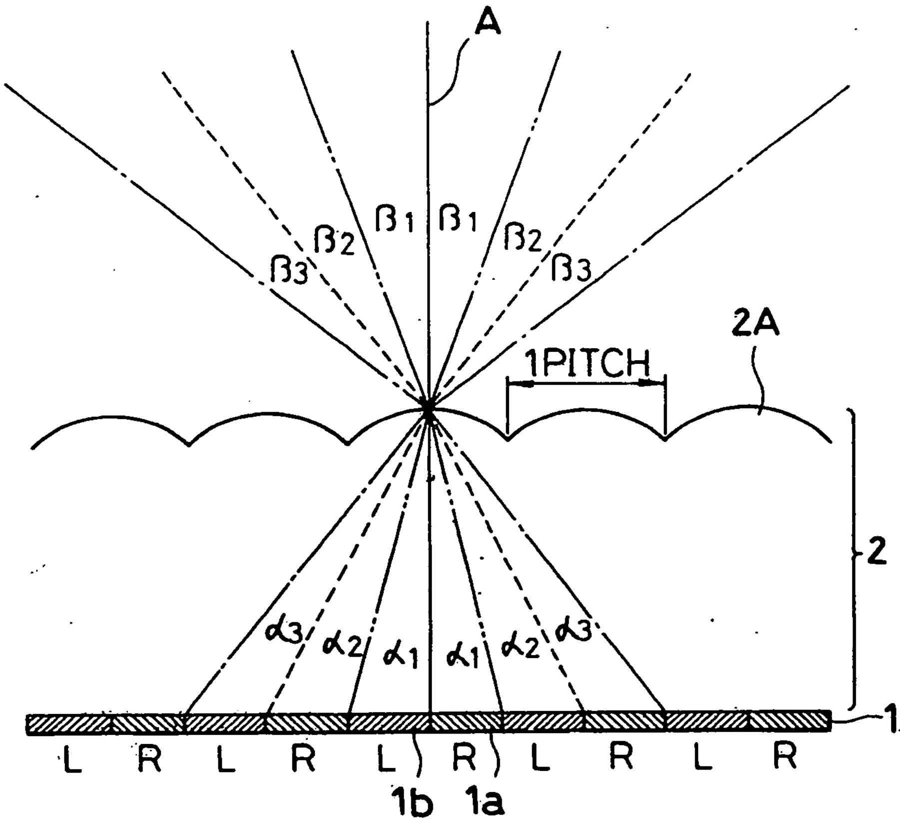


FIG.2

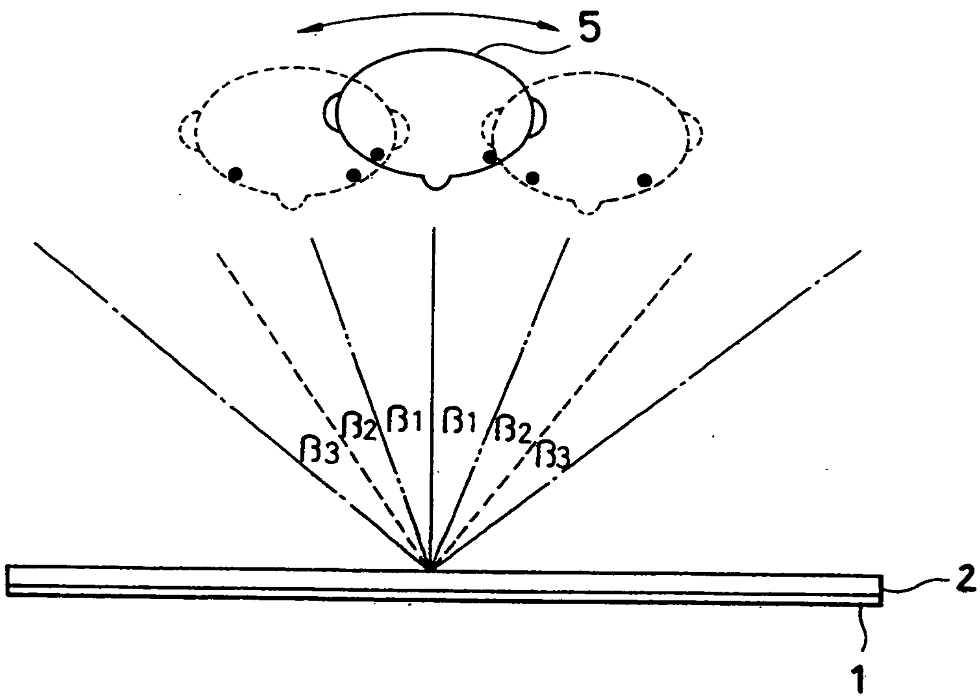


FIG.3

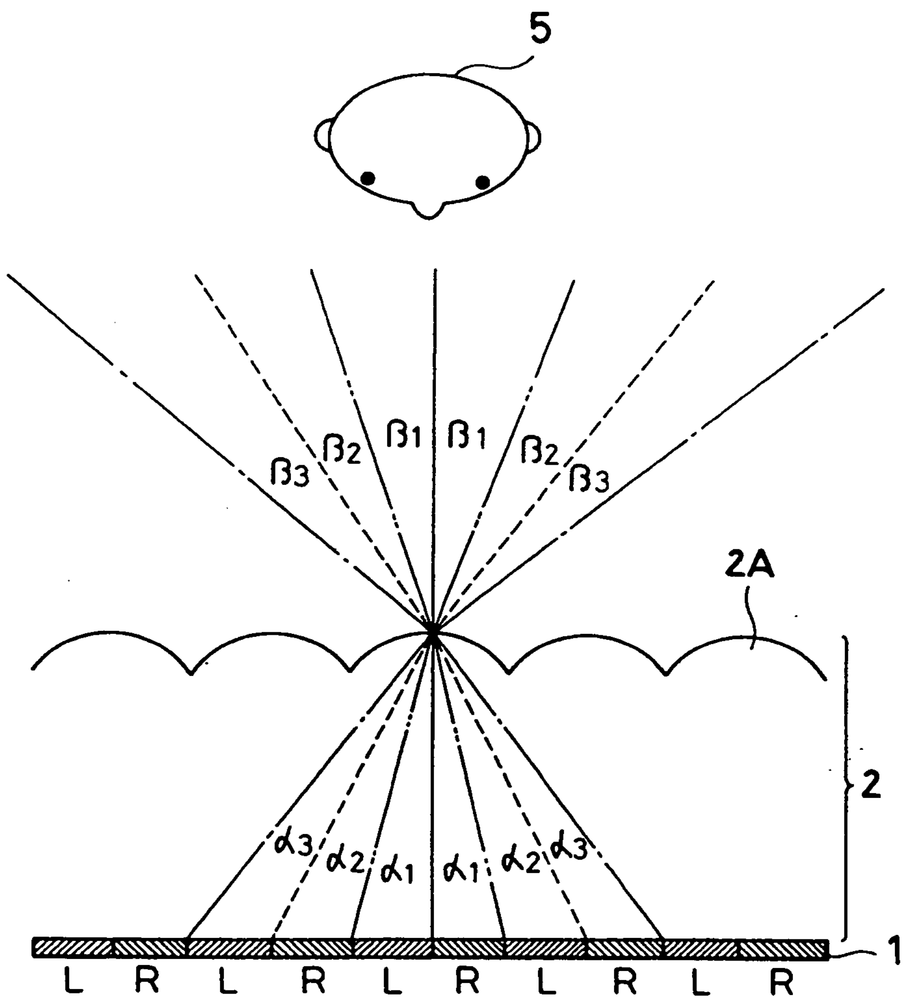


FIG. 4

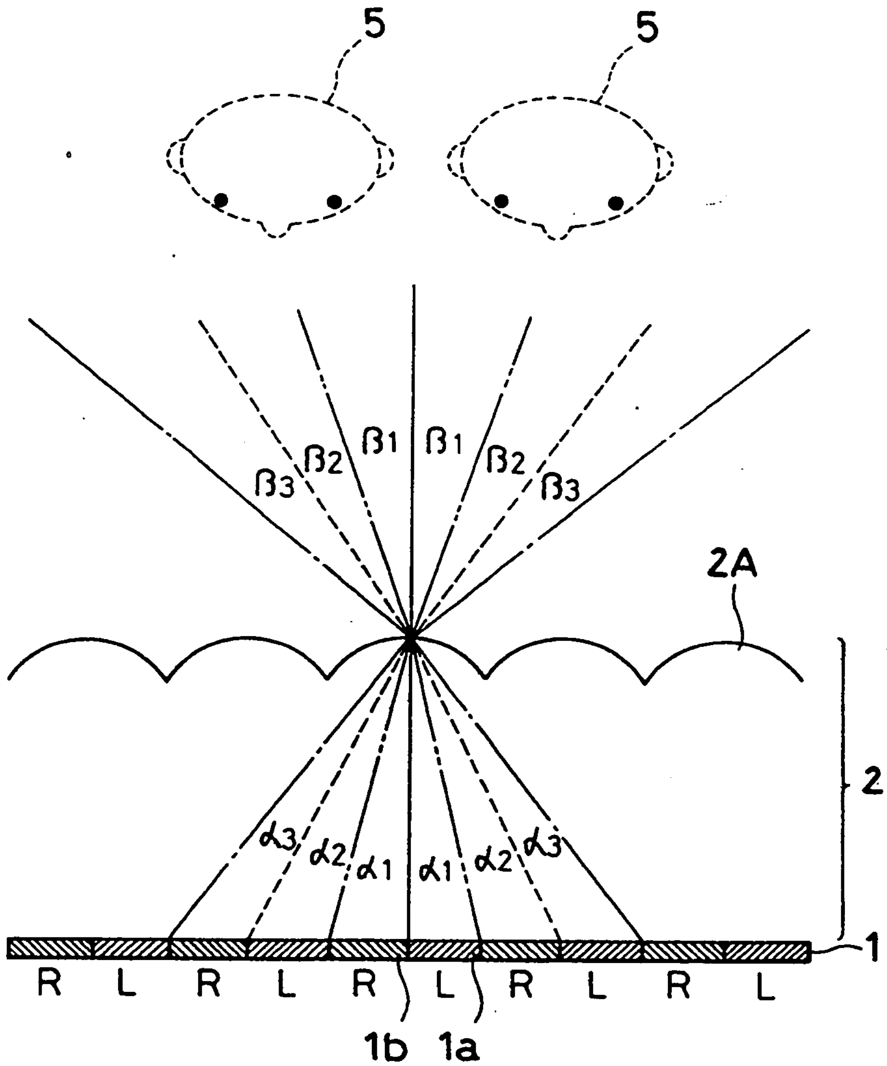


FIG.5(A)

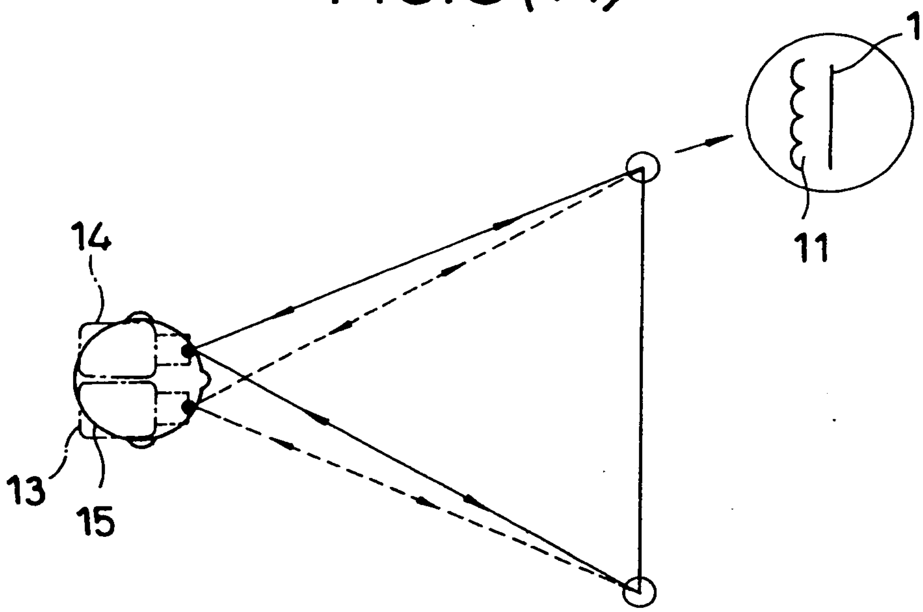


FIG.5(B)

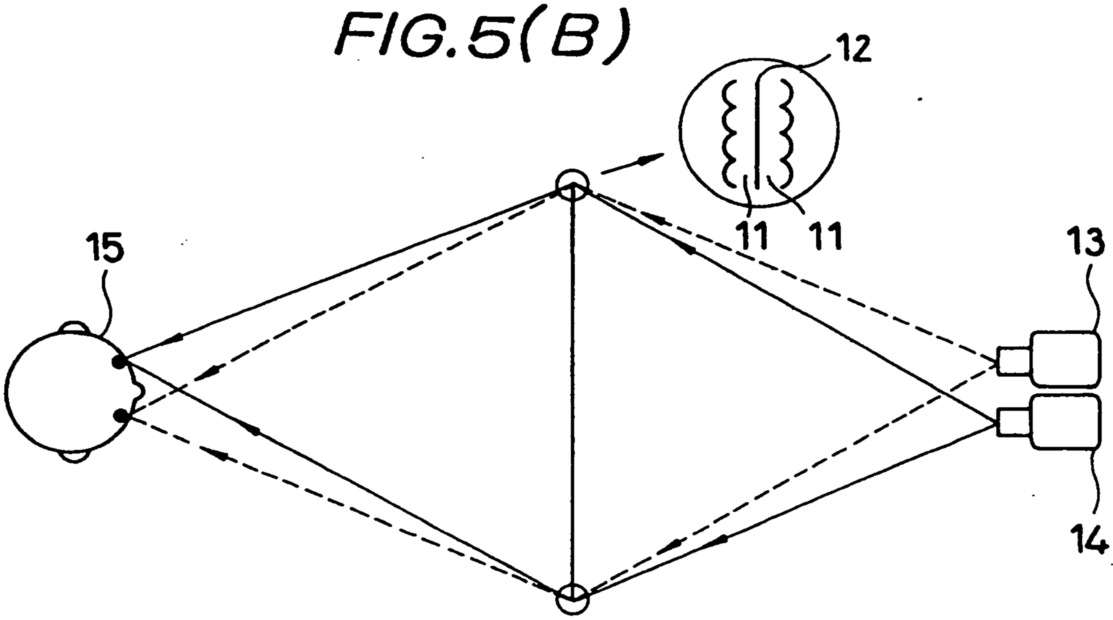


FIG.6

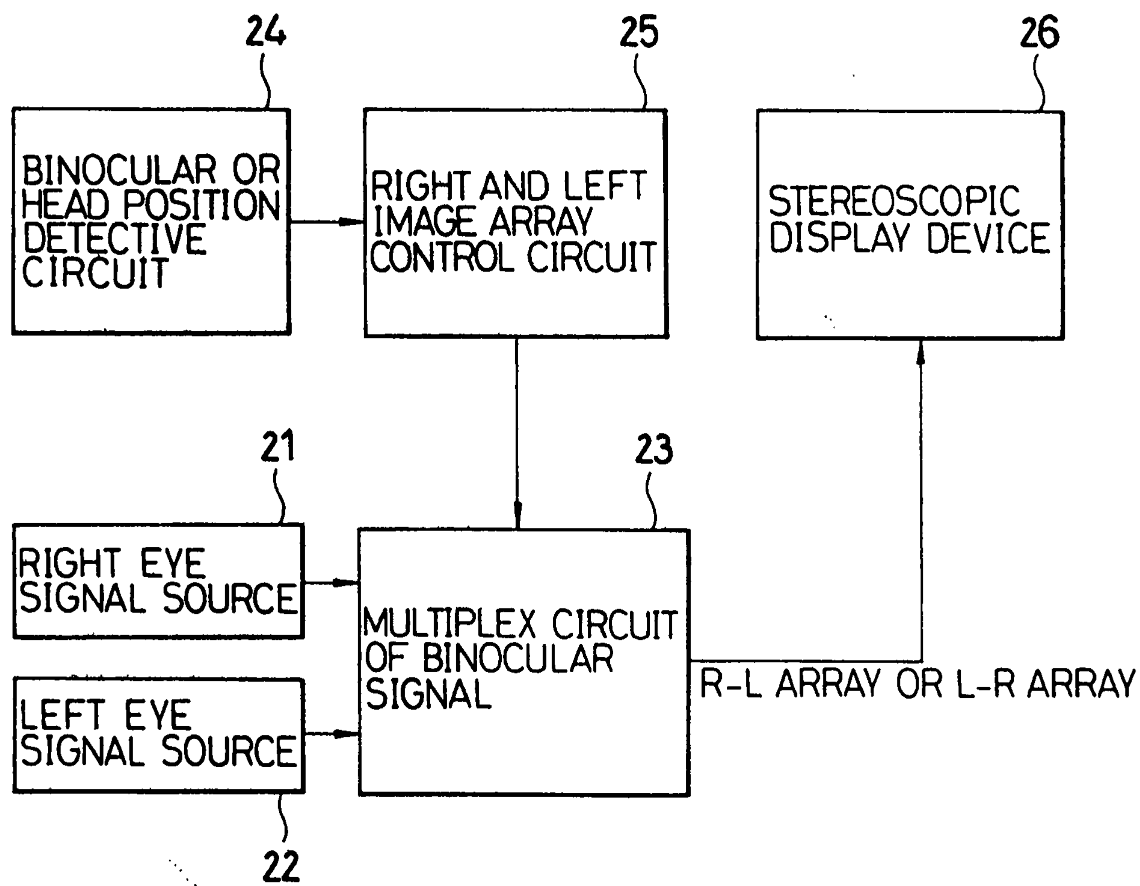

24
BINOCULAR OR HEAD POSITION DETECTIVE CIRCUIT
25
RIGHT AND LEFT IMAGE ARRAY CONTROL CIRCUIT
26
STEREOSCOPIC DISPLAY DEVICE
21
RIGHT EYE SIGNAL SOURCE
22
LEFT EYE SIGNAL SOURCE
23
MULTIPLEX CIRCUIT OF BINOCULAR SIGNAL
R-L ARRAY OR L-R ARRAY

FIG.7

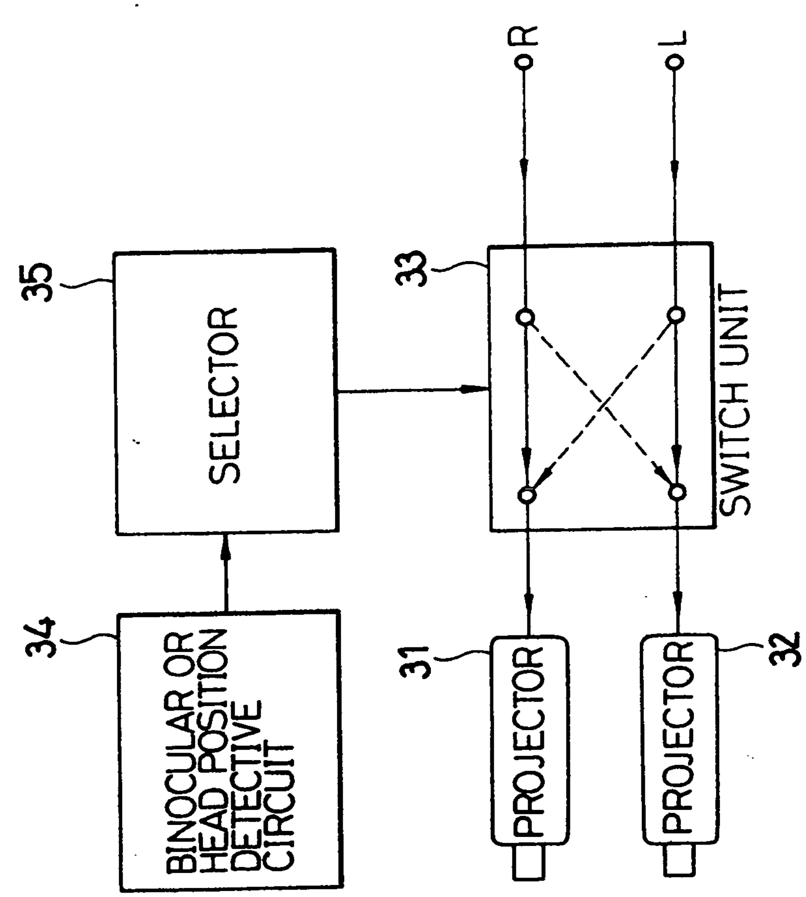
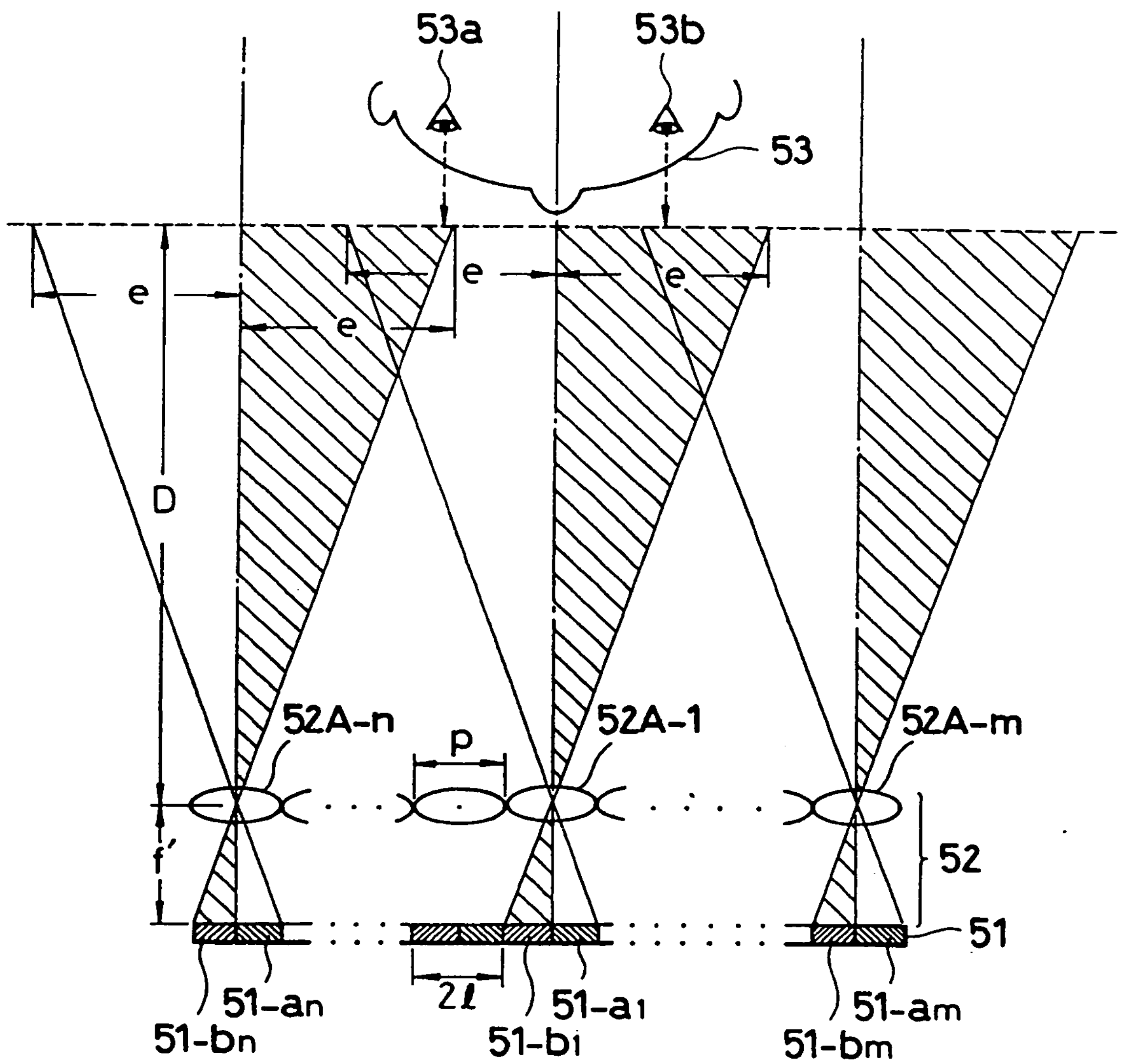

BINOCULAR OR HEAD POSITION DETECTIVE CIRCUIT
34
SELECTOR
35
SWITCH UNIT
33
R
L
PROJECTOR
31
PROJECTOR
32

FIG.8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53b
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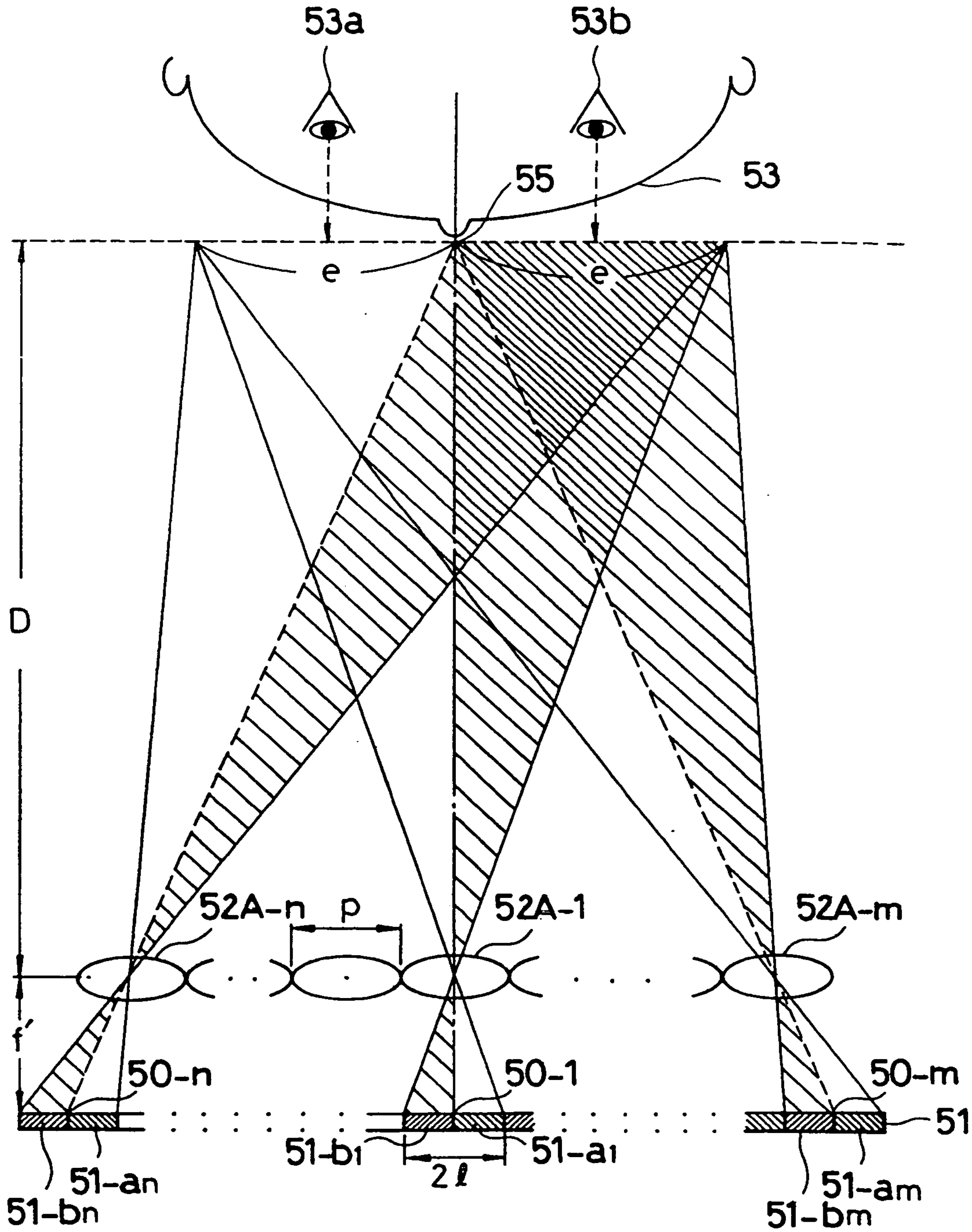
e
e
e
e
D
52A-n
p
52A-1
52A-m
f'
52
51
51-an
2ℓ
51-a1
51-am
51-bn
51-bi
51-bm

FIG.9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53b
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53
e
e
D
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p
52A-1
52A-m
f′
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50-1
50-m
51
51-b1
51-a1
2ℓ
51-an
51-bn
51-am
51-bm

FIG.10(A)

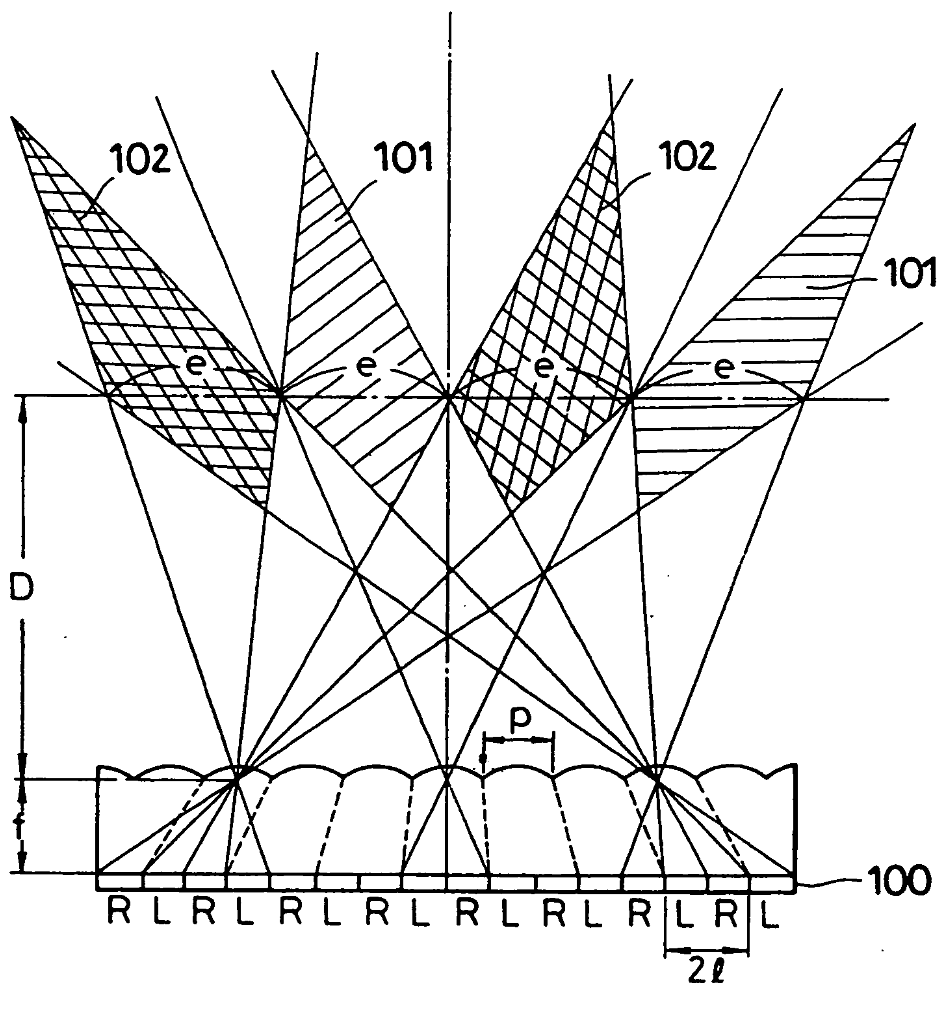


FIG.10(B)

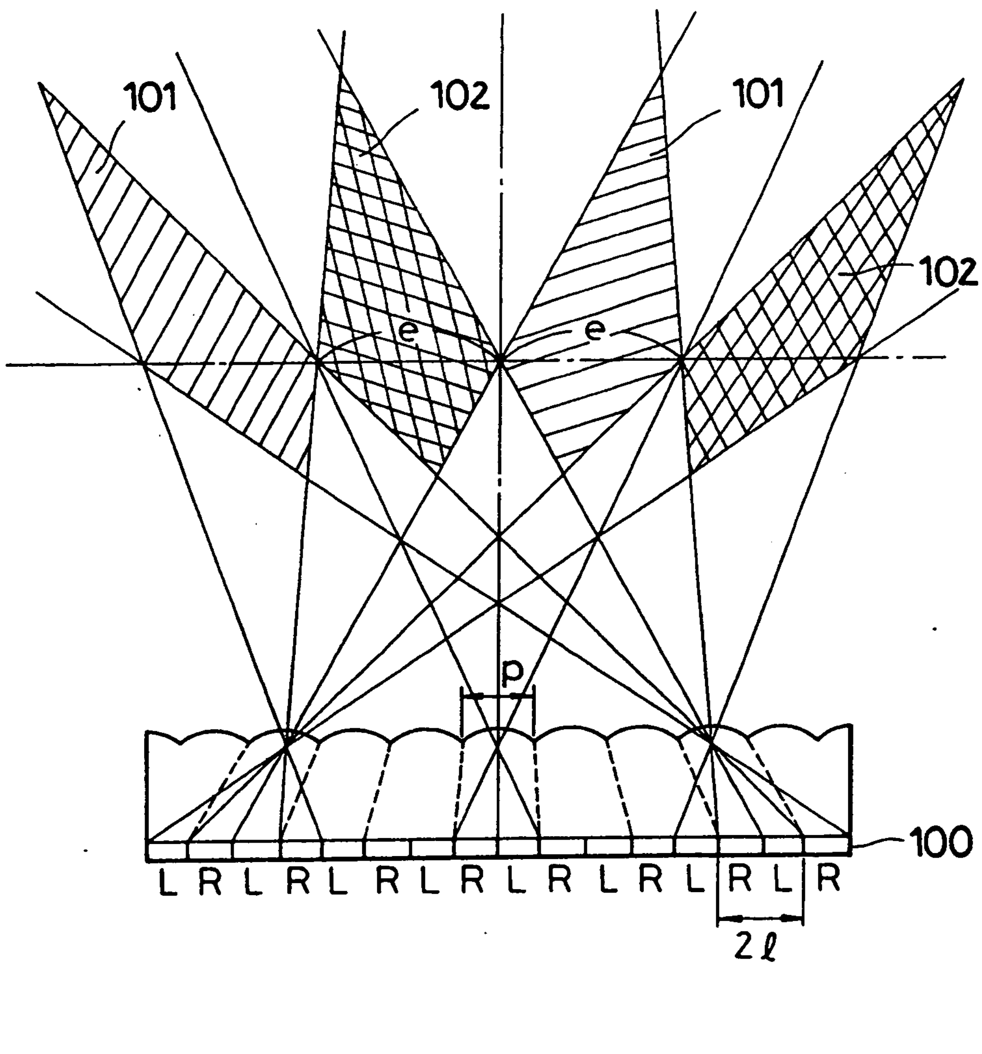
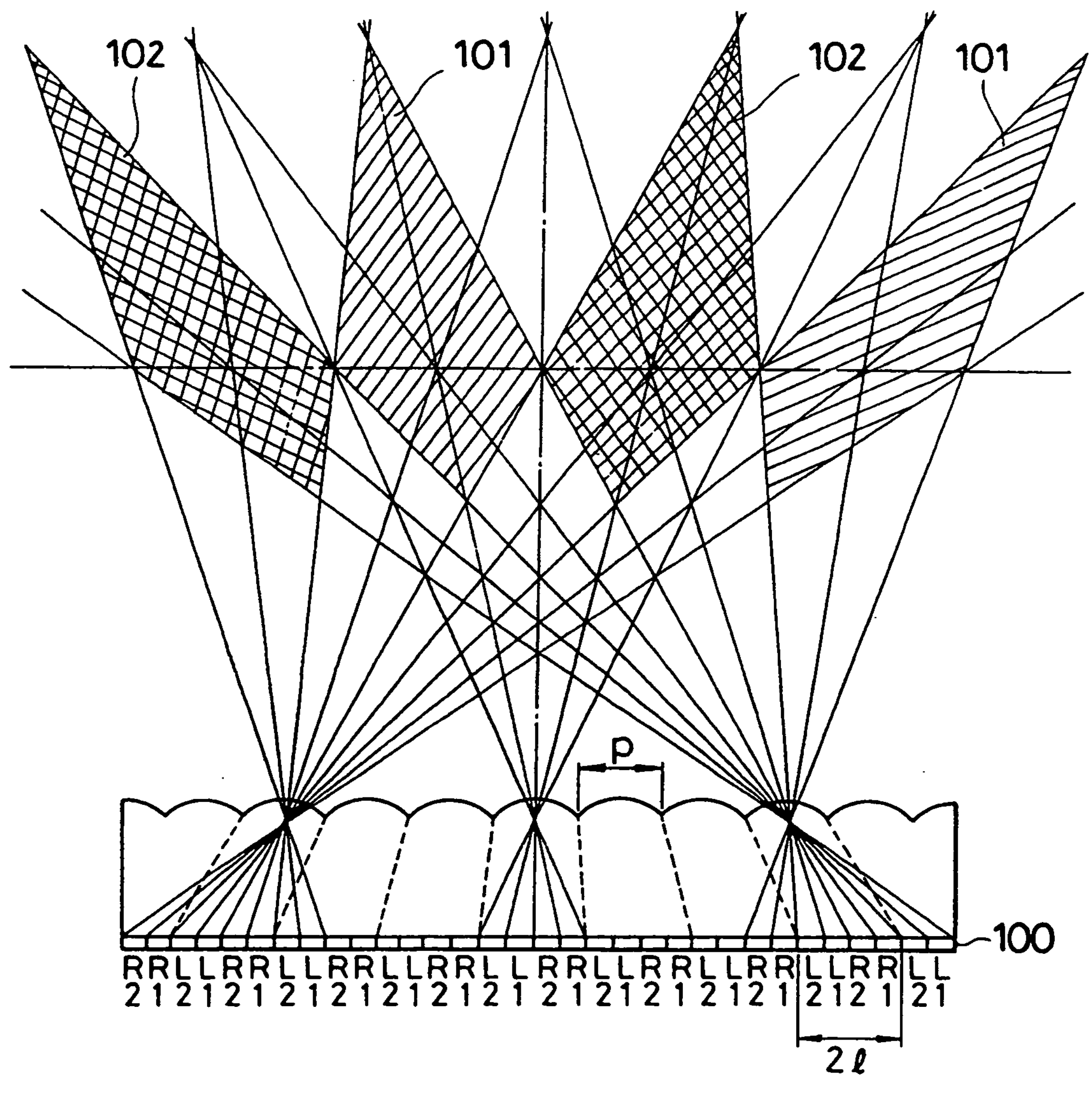


FIG.11(A)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101
102
101
p
100
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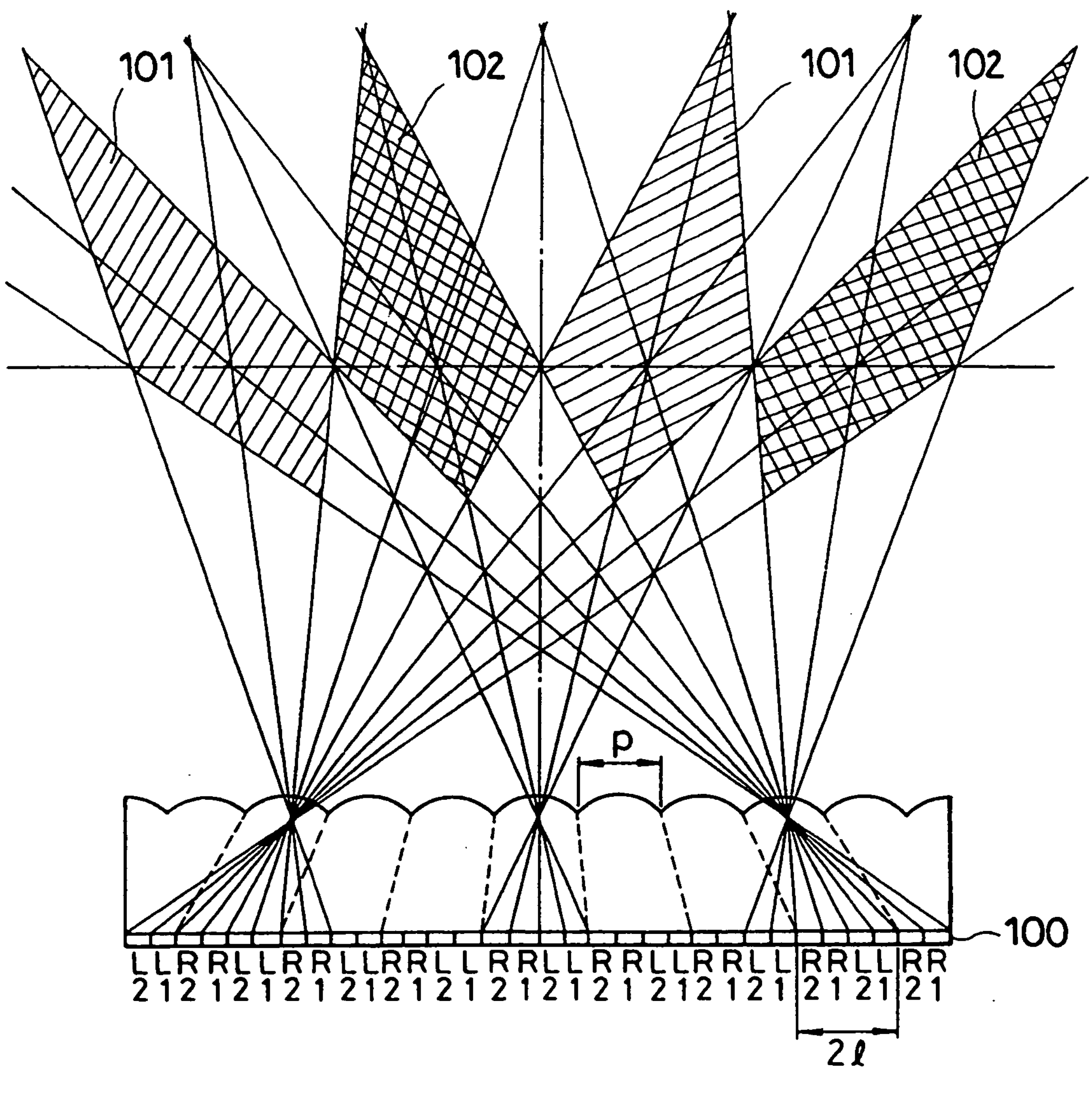
2ℓ

FIG.11(B)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102
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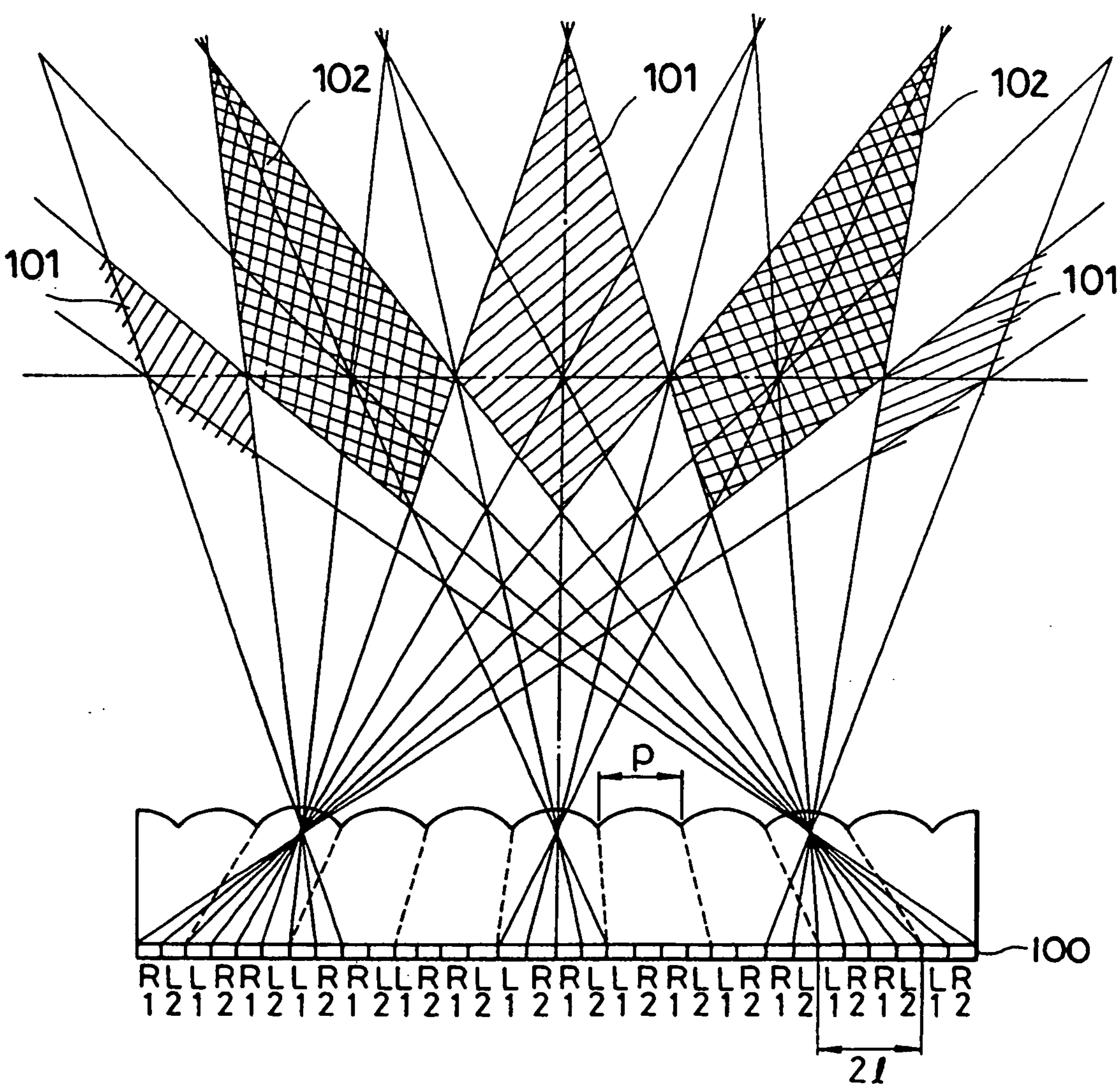
100
L L R R L L R R L L R R L L R R L L R R L L R R L L R R L L R R
2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1
2ℓ

FIG.11(C)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101
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p
100
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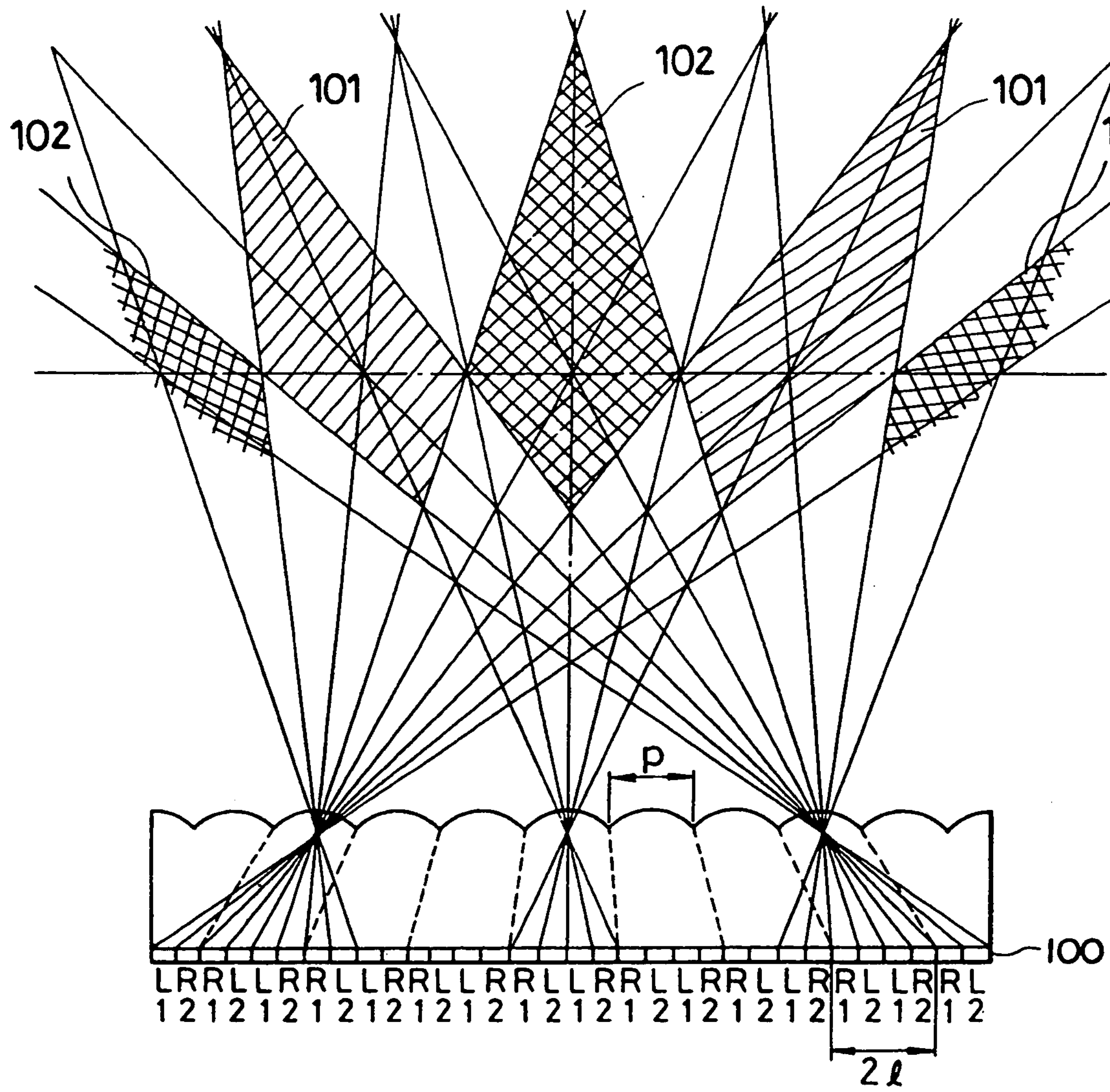
2l

FIG.11(D)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p
100
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1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2
2ℓ

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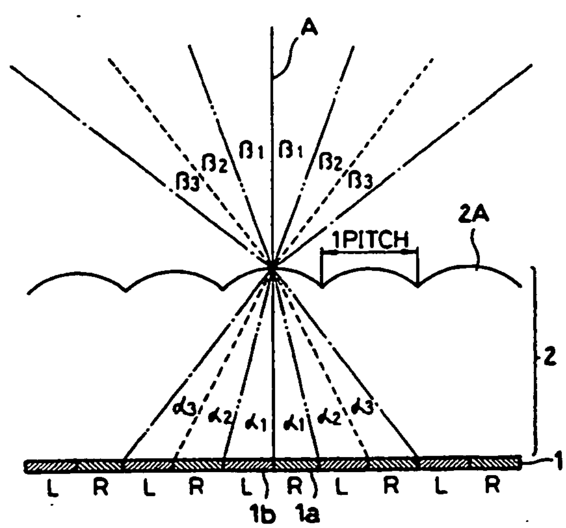
(54) **Technique of stereoscopic image display.**

(57) The technique uses a viewing lenticular lens sheet constituted by an array of lenticular lenses on which a combined image obtained by combining pixels for the right and left eye images having binocular disparity data. This technique comprises the steps of :
detecting a position of the viewer ; and
changing positions of the pixels for the right and left eye images on the combined image in accordance with the detected position of the viewer, so that the right and left eye images are always correctly provided to the right and left eyes of the viewer.

FIG. 1



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Eur pean Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 40 2262

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
P,X	1989 SID INTERNATIONAL SYMPOSIUM, DIGEST OF TECHNICAL PAPERS, vol. XX, May 1989, pages 188-191, Baltimore, US; S. ICHINOSE et al.: "Full-color stereoscopic video pickup display technique without special glasses" * Whole document *	1-7	H 04 N 13/04 G 02 B 27/22
D,A	IEEE TRANSACTIONS ON ELECTRON DEVICES, vol. ED-33, no. 8, August 1986, pages 1123-1127, New York, US; A. SCHWARTZ: "Head tracking stereoscopic display" * Page 1123, right-hand column, line 37 - page 1124, right-hand column, line 13; figure 3 *	1	
A	EP-A-0 262 955 (BASS) * Column 4, lines 10-28; column 5, line 15 - column 7, line 6; figures 3,5 *	1,2	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 04 N
G 02 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04-10-1990	BEQUET T.P.

CATEGORY F CITED D CUMENTS

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